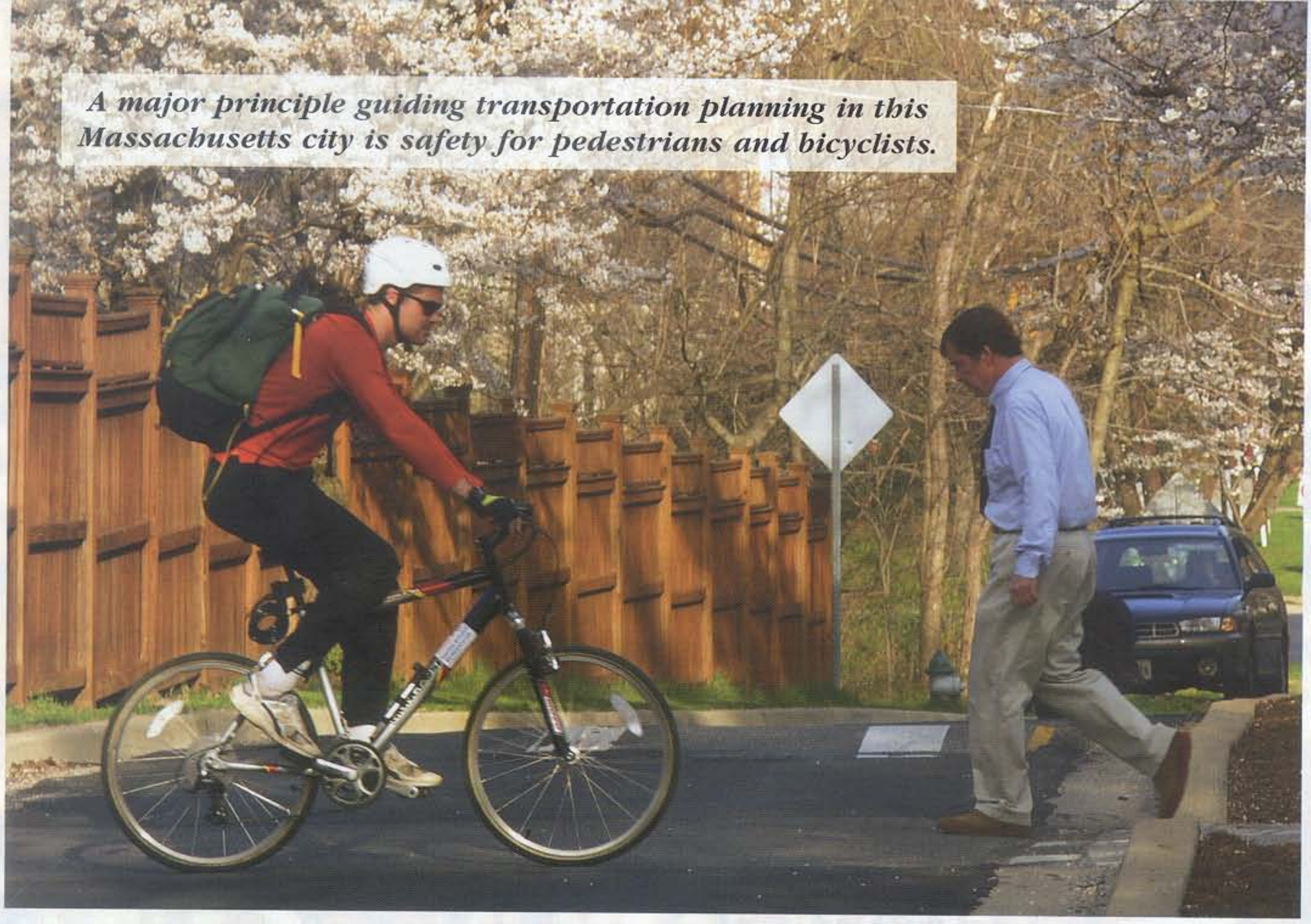


A major principle guiding transportation planning in this Massachusetts city is safety for pedestrians and bicyclists.

Cambridge Plans A Livable Community

by Jeff Parenti

Improving the safety of the transportation network is an ongoing challenge, especially because many people still think of safety only in terms of vehicle occupants. However, of the 43,443 people killed by vehicles on U.S. roadways in 2005, 13.5 percent were nonoccupants, a group composed mainly of pedestrians and bicyclists.

Many urban areas increasingly feature sidewalks, bicycle lanes, and other amenities for nonmotorists as part of a sustainable transportation landscape. But to sustain safety, communities that are encouraging people to walk or bike on streets dominated by vehicles will need to make the safety of pedestrians and bicyclists a priority.

To foster pedestrian and bicyclist safety, one of these communities—the city of Cambridge, MA—uses a blend of multidisciplinary collaboration, aggressive policies, innovative engineering approaches, and a citywide policy that automobiles are not the only mode of travel.

"Our goal in Cambridge is to shift people from using cars to using other modes of transportation, like biking, walking and using public transit," says Henrietta Davis, a member of the Cambridge City Council who has sat on the Traffic, Parking, and Transportation Committee for 8 years. "We work on eliminating obstacles and creating incentives. For walking, for example, are the sidewalks safe and free of tripping hazards? Is snow and ice cleared so that on the snowiest days people don't decide to drive because sidewalks aren't clear and they don't feel safe walking?"

More broadly, any number of societal goals can help drive a push for safety. In Cambridge, the environment is a big concern. "Transportation planning should reflect our long-term vision of Cambridge as a livable, inclusive, and sustainable community," says Susanne Rasmussen, director of environmental and transportation planning for the Cambridge Community Development Department (CDD). "Cambridge has pledged to reduce its greenhouse gas emissions by 20 percent by 2010. Some of those reductions need to come from people driving less, and we have a responsibility to create a city that makes that both possible and desirable," she says.

(Above) A bicyclist and pedestrian pass each other crossing a road as a car approaches. Cambridge, MA, has made notable inroads in balancing the safety concerns of all three modes of transportation. *Photo: AAA Foundation for Traffic Safety.*

Embracing a Vision

A single project or program is unlikely to make a locality walkable or bikeable overnight. Nor will any individual action, no matter how well funded, reduce the number of trips motorists choose to drive alone. Fundamental changes in the transportation landscape require the cooperation of multiple stakeholders—elected officials, municipal staff, residents, and business owners—agreeing that walking and bicycling are important. Obtaining agreement is not easy because some believe that more cars bring more people and economic development.

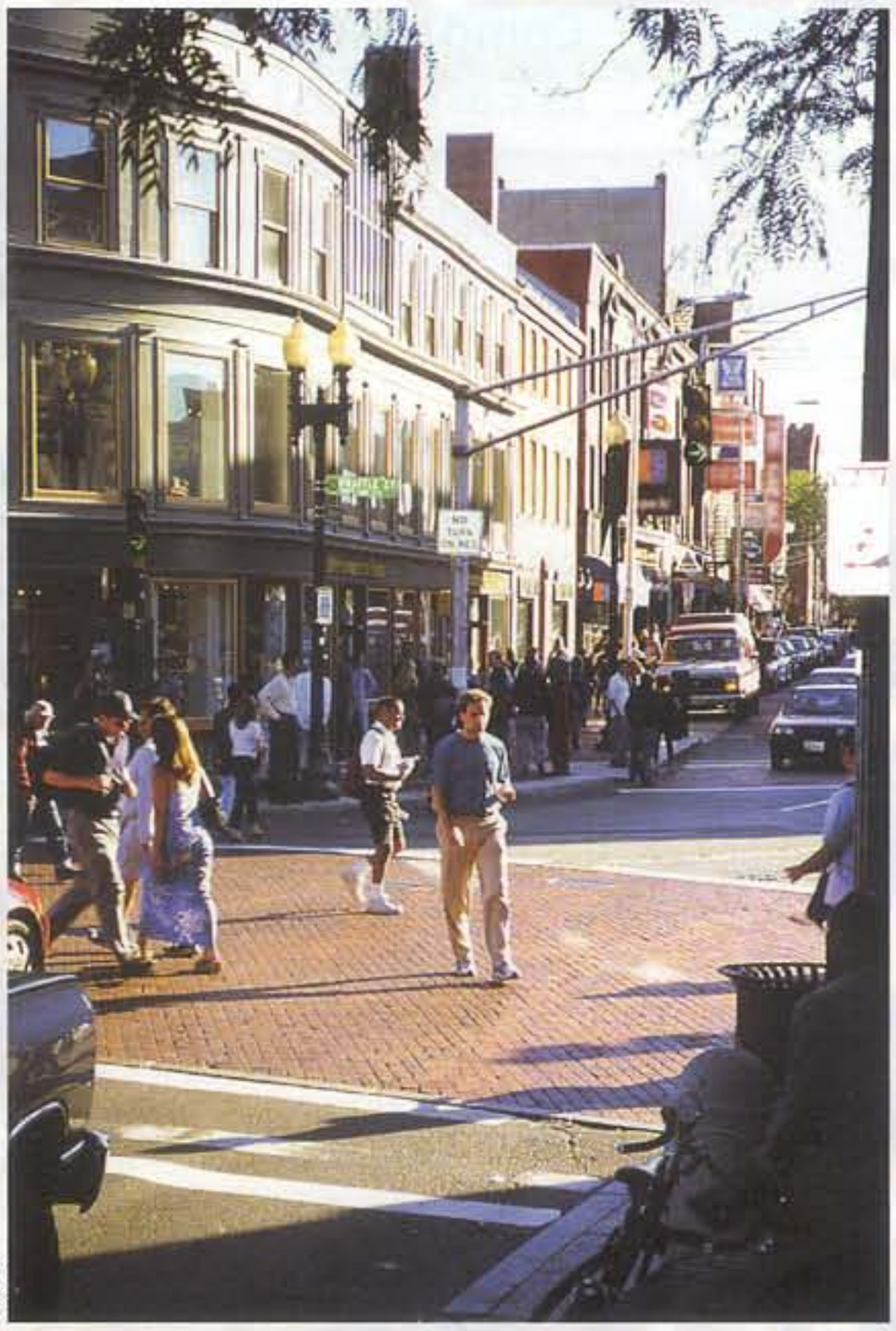
Cambridge explicitly states its attitude toward nonmotorized traffic in writing in CDD's *Pedestrian Plan* in 2000. More than 100 pages in length, the plan explains that walking is important to Cambridge's vision and articulates the importance of nonmotorized alternatives: "A walkable city is especially important for people with disabilities, the elderly, children, and people who cannot afford to keep a car." A walkable community can help to create a thriving economic base, vital and distinctive retail centers, and strengthened and stabilized neighborhoods, according to the plan's authors. Walking also prevents pollution and promotes good health. Cambridge's embracing of pedestrians and bicyclists is especially important in a community with little room to accommodate the rising number of automobiles.

A look at modal split is one means of measuring an area's attitude toward multimodalism. According to journey-to-work data from the 2000 census, a minority of Cambridge residents traveled to work by driving alone; in fact, barely one-third did, less than half the figure for the rest of Massachusetts. Nearly 30 percent of Cambridge residents walk or bike to work. This modal split, with so little reliance on the automobile, is rare for a municipality in the United States, and no other city matches the Cambridge proportion of human-powered means. Cambridge is different even from other cities with similar population densities.

About Cambridge

First settled as a town in 1636 and established as a city in 1846, Cambridge lies across the Charles River from downtown Boston. Harvard College (now University) in Cambridge also was founded in 1636, and at that time only a few roads connected the school to the villages of East Cambridge, Cambridgeport, and neighbors such as Arlington. As Cambridge's population grew, few additional major arteries were constructed. Today, Cambridge's 100,000 residents, living within 16.6 square kilometers (6.4 square miles), still are carried principally by those few routes, as are the 106,000 people who work in Cambridge, the annual 2.5 million tourists, and tens of thousands of people who simply pass through Cambridge on their way to and from other destinations.

Harvard Square, with all four corners easily accessible on foot, attracts a mix of students, tourists, residents, and businesspeople, helping to meet Cambridge's goal of sustaining diverse neighborhoods and thriving commercial areas.



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Although students from the Massachusetts Institute of Technology, Harvard University, and other neighboring campuses comprise a significant portion of the community, Cambridge is not the typical college town. About 10 percent of the population is elderly. The city contains 2 centers for senior citizens and 7 buildings housing 50 or more seniors. These facilities will become even more important as the 45 to 65 age group, which has grown by one-third since 1980, begins to retire.

The city uses the Plan E form of government, also known as the "weak mayor" system because the city manager has executive powers. In addition, the mayor is not elected; rather, one of the nine elected members of the Cambridge City Council is chosen to serve under the title of mayor. Each neighborhood is represented by an association, again showing the close involvement of the citizenry in the city's affairs. Several council-appointed advisory

Multimodalism: A Comparison of City And State Commuters (Percentages)

Means of Travel	City of Cambridge	Commonwealth of Massachusetts
Drive Alone	35.3	73.8
Transit	24.9	8.7
Rideshare	5.2	9.0
Bike	3.9	0.4
Walk	24.3	4.3
Other	1.1	0.5
Work at Home	5.3	3.1

Source: Cambridge Traffic, Parking & Transportation Department.

Comparison of Multimodal Splits In East Coast Cities (Percentages)

Means of Travel	Cambridge	Boston	New York	Philadelphia	District of Columbia	Baltimore
Drive Alone	35.3	41.5	7.6	49.2	38.4	54.7
Rideshare	5.2	9.2	3.4	12.8	11.0	15.2
Transit	24.9	32.3	59.6	25.4	33.2	19.5
Bike or Walk	28.2	14.0	22.8	9.9	13.0	7.4
Other	1.1	0.6	0.8	0.7	0.7	0.8
Work at Home	5.3	2.4	5.8	1.9	3.8	2.3

Source: Census Transportation Planning Package.

committees meet every month, including separate committees and meetings for both pedestrian and bicyclist issues. Few major activities occur without input from the community.

Cambridge employs more than a dozen professionals in several departments who spend at least part of their time thinking about multimodalism. Some do so full time. Most of these professionals work in CDD's Environmental and Transportation Planning Division. This division has seven planners and two engineers, including a full-time project manager for traffic calming and a parking and transportation demand management (PTDM) officer. In addition, the Traffic, Parking & Transportation Department (TPTD) has two engineers and one planner. These professionals collaborate on all traffic calming, intersection, and streetscape improvement projects. On the enforcement side, the Cambridge Police Department includes 12 officers on bicycles. The police department aggressively enforces Commonwealth laws not only regarding vehicles failing to stop for pedestrians at crosswalks, but also the police stop cyclists who do not wear a helmet or use a headlight. Cambridge also has an ordinance requiring drivers to use care when opening a door into traffic, an effort to prevent "dooring" crashes involving bicycles.

"Close coordination among all relevant city departments has been critical to our success," says Rasmussen. "Monthly interdepartmental meetings with staff from [the Department of] Public Works; Traffic, Parking & Transportation; the Commission for Persons with Disabilities; and Community Development Department, as well as other departments on an as-needed basis, are key to making sure that roadway construction and repair projects capture opportunities to improve our streets and sidewalks for all users."

In some municipalities, for example, the public works department might not support the idea of traffic calming immediately, because curb extensions, for instance, impede snowplowing. Similarly, a fire department might oppose raised crosswalks because they reduce response times. But staff members from all of Cambridge's departments recognize the benefits of traffic calming and of working together generally, and are willing to discuss alternatives. The Cambridge Department of Public Works (DPW) and Cambridge Fire Department participate fully in the planning process.

Says Rasmussen: "From the beginning, the departments involved in designing traffic calming measures, such as curb extensions, raised devices, or chicanes [a set of two or three alternating curb bulbs or extensions that narrow a street], have worked closely with the [Cambridge] Fire Department to make sure that the proposed measures do not hamper emergency response. This review process, which often includes marking out the proposed devices and doing test runs with fire apparatus, has resulted in a very successful traffic calming program that is not in conflict with the need to respond quickly and effectively to emergencies."

Whether planning a single curb extension or a multimillion-dollar streetscape reconstruction, Cambridge officials consider impacts on and accommodations for pedestrians and cyclists at the start of each project. As a result, over time, Cambridge streets have incorporated these alternative modes of transportation.

Pedestrian- and Bicyclist-Friendly Programs

In addition to engineering and planning efforts, Cambridge uses dozens of other ways to ensure that walking and bicycling remain viable travel modes. Here are a few examples:

Snow exemption program. The Boston area receives about 1.1 meters (3.5 feet) of snow each year. Landowners are required to clear snow from public sidewalks abutting their property, which provides a continuous walking path safely off the street. Many elderly residents are physically unable to comply, so DPW performs the work when requested.

Traffic management at construction sites. Regardless of whether a project is public or private, the contractor must submit an engineering plan for the construction site. The plan must provide a temporary sidewalk, and often a bicycle lane, even if a parking or travel lane must be removed. Contractors are never allowed to close a sidewalk and force pedestrians to use the opposite side of the street.

PTDM. Each large employer in Cambridge is required to have a plan for helping its workers commute by

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Massachusetts Avenue remains a major thoroughfare for Cambridge and its 100,000 residents. Here, at Harvard Square, more than 1,500 pedestrians cross the street in each peak hour.

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This raised intersection replaced a traffic signal. In the mornings, this area is crammed with students walking to Morse Elementary School, just out of view to the left.

means other than driving alone. For example, employers might choose to employ strategies such as bicycle parking, shower facilities, emergency ride home programs, and rideshare matching, or incentives such as pretax deduction of transit and vanpool fares. The city's PTDM officer reviews the plans and works with the businesses to improve them when necessary.

In-pavement lighting. In one example of the city's willingness to explore new ideas, a developer installed flashing in-pavement lighting at a public crosswalk linking a building with a parking garage. Since then, city staff, residents, and developers have proposed several other ideas, such as an on-sidewalk "bicycle track" on the MIT campus and three traffic signals intended to control bicycle traffic, all of which have been built or are nearly complete, and some of which have been studied to measure their effectiveness.

Engineering Solutions

Cambridge residents have access to several shared-use paths within the city's borders. The community is bounded on the east and south by the Charles River, which is bordered on each riverbank by the Paul Dudley White Bicycle Paths. Another asset is the Minuteman Bikeway—the Nation's 500th rail-trail—that stretches from the Alewife neighborhood 17.7 kilometers (11 miles) northwest into the suburbs. A third rail-trail, the Linear Park Path, accommodates nonmotorized trips to Somerville, the neighboring city to the north.

Simple density is an important component of the modal split numbers. Aside from raw population density, Cambridge's four major commercial districts—Central, Kendall, Harvard, and Porter Squares—fulfill much of the public's needs within short walking or bicycling trips. The squares also are natural sites for the stations on the Massachusetts Bay Transportation Authority's red line subway.

But just having things nearby is not enough. If transportation practitioners expect people to walk or bike instead of drive, they must make the entire trip as safe, efficient, and inviting as possible. To do this, Cambridge has been diligent and meticulous in improving its infrastructure to encourage walking and biking—without a noticeable detriment to vehicle operations.

One infrastructure element important to safety is traffic signals. The Cambridge TPTD has set policy for intersections and enacted the following operational changes to 135 traffic signals throughout Cambridge:

Cycle length. Pedestrian delays increase with the cycle length of traffic signals. Cambridge engineers set the maximum cycle length to 90 seconds. At locations where an intersection has three or more phases, the city may use longer cycles, but never longer than 120 seconds. Although in most municipalities the ultimate goal is to minimize delay for vehicles, Cambridge does not seek to provide optimal vehicle level of service (LOS) and in fact considers "LOS D"—a condition where the influence of delay becomes more noticeable—to be acceptable. Rather, it aims to provide the best possible level of service for pedestrians as defined in the *Highway Capacity Manual 2000*.

Pedestrian signal operations. The policy sets pedestrian signals to operate concurrently with vehicle green lights, with leading pedestrian intervals (LPI) that provide a head start for pedestrians by turning on the "Walk" signal a few seconds before the green light is shown to vehicles. This short interval gives the pedestrian enough time to move several meters into the crosswalk. With the pedestrian already occupying the crosswalk, even the least considerate drivers have little choice but to yield before turning. Naturally, LPIs work best when the pedestrian volumes are higher. In Central Square, a truck-laden right turn is successfully countered by LPIs, and about 500 pedestrians cross in the peak hour of the morning. The LPI interval is 3 seconds long, and has what city officials deem a minimal effect on vehicle operations.

Countdown pedestrian signals. Cambridge officials decided to make

AAA Foundation for Traffic Safety

Construction at the road edge, such as this work being done in Washington, DC, can hamper bicyclists and pedestrians. In Cambridge, however, contractors are required to maintain easy, safe passage for all nonmotorized users.

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Concurrent pedestrian phasing allows 60 seconds and longer for crossing in some Cambridge locations, as indicated by this countdown signal head.

the numerical countdown legend standard, along with light-emitting diode (LED) international symbols, in its pedestrian signal heads. The device displays the number of seconds remaining until the flashing "Don't Walk" interval ends, then disappears after 0 is shown. Engineers determine the duration of the flashing "Don't Walk" interval by assuming a walking speed, generally, of 1.2 meters (4 feet) per second. However, most people walk faster, and some are even willing to run. On the other hand, others, often the elderly, walk slower. The countdown legend enables the walker to decide if there is enough time to cross the street safely.

Because Cambridge has roughly 1,000 pedestrian signal heads and replacing all of them would not be feasible, the policy contains earmarks for upgrade locations with high pedestrian volumes and long "Don't Walk" cycles. Although little research has been done on the effectiveness of countdown signals, the public continues to request additional ones. The TPTD wants to phase in more such signal heads in the future.

Interaction With Senior Citizens

Cambridge's senior centers and senior living buildings often host members of the Cambridge City Council and their staff to discuss various matters, including traffic. At a recent "town meeting," the following were some of the most common comments from attendees:

Adequate time to cross the street is of utmost importance. Many elderly citizens reported that they are unable to walk as quickly and would appreciate longer crossing intervals. TPTD responded by extending the flashing "Don't Walk" time, assuming a walking speed of 1.1 meter (3.5 feet) per second in places with a high volume of elderly pedestrian traffic.

Pedestrians have a difficult time trusting the "Walk" indication if a car races past. Red-light running is a problem in Cambridge, and TPTD has employed several techniques to address it, such as increasing the all-red interval, increasing enforcement, and pursuing the use of red-light cameras.

Countdown signals are helpful, but the numerals can be hard to read. The numeral size on countdowns is fixed at about 25.4 centimeters (10 inches) high, and from across a wide street this size may not be legible to those with imperfect vision. The city is investigating emerging signal equipment products that provide larger legends.

LPI does not always result in yielding to pedestrians. This is a common complaint from all age groups. LPI works less well when pedestrian volumes are low or when turn radii are large. The latter can be remedied with improved design. For example, traffic calming techniques such as "neckdowns" (curb extensions at intersections) reduce the speed of turning cars, which improves the yielding rate.

More audible signals should be installed. Although the "chirp" and "cuckoo" tones are intended for the visually impaired, they can prompt the sighted as well.

Measures of Effectiveness

Using a multidisciplinary approach, officials with TPTD collected and analyzed crash data to study the effect that multimodalism might have on safety.

In 2004, 2,053 crashes occurred in Cambridge, or about 20 per 1,000 residents. In comparison, Massachusetts averaged 22 crashes per 1,000 residents, despite being 19 times less dense than Cambridge. The number of crashes in Cambridge has declined every year since 1998—the same year the first traffic calming device was installed—while statewide the number has remained steady.

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Clearly delineated bicycle lanes such as this one help improve nonmotorist safety across the country.

When comparing Cambridge's pedestrian crash rates to national and statewide rates, TPTD officials calculated rates using population as a denominator because there is no such measure as "miles walked." Therefore, comparing crash rates for the 100,000 Cambridge residents, who each make several walking trips a day on average, to 100,000 people elsewhere is an apples-to-oranges statistical dilemma. About 100 crashes involving pedestrians occur in Cambridge each year, steady since 1990. Assuming that the number of walking trips has grown since then, TPTD officials believe that the pedestrian crash rate—calculated using miles walked—has decreased.

Moreover, when crashes involving pedestrians in Cambridge do occur, they tend to happen at low speeds and result in few and minor injuries. The pedestrian accepts transport to a hospital in a little more than half of all crashes. In a study of 105 crashes between January 2004 and August 2005, every pedestrian but one was alert and was able to provide a report to the police officer at the scene. No fatalities were reported.

TPTD found no pattern in the causes of pedestrian crashes for January 2004 through August 2005, but TPTD officials were surprised that none involved a car running a red light, drunk driving, speeding, or young drivers (16- or 17-year-olds). The most common cause found was failure to yield, cited in 17 of the incidents. Just six crashes occurred when a pedestrian was using a "Walk" signal with the traffic green light, while nine involved jaywalking. A close look at bicycle crashes yielded similar results. Bicyclists also are involved in about 100 crashes per year. This number has remained steady since 1990 even while the number of bike trips has risen, a trend discovered through formal spot counts conducted by the city. A crash rate for bicyclists is equally difficult to calculate without a means to determine "bicycle miles traveled," but citywide the rate is likely decreasing.

An even smaller proportion of bicyclists than pedestrians is injured in crashes with vehicles. In a city study of 86 such crashes between January and November 2005, less than half accepted medical assistance, and there were no fatalities. Bicyclists striking opening car doors accounted for one quarter of all crashes. Adequately sized bike lanes help reduce these "dooring" incidents, and the city is always looking for opportunities to provide a 1.5-meter (5-foot) bike lane adjacent to parking. When space is limited, the city has found creative ways to separate parked and moving cars from bicyclists, such as bike "guide lines" and using "share the road" signs and road markings.

TPTD continues to collaborate with the Cambridge Police Department on crashes involving pedestrians and bicycles. Also, TPTD updates its database with information from each detailed report it receives from the police and uses this information to propose and execute engineering changes on the street.

"We don't have the best luck with enforcement," notes Davis, the city councilor. "Cars park in the bike lanes. Drivers 'door' bicyclists. These are challenges—getting the police to see how much is at stake making the roads safe for walkers and bikers."

She adds, "We create partnerships with our citizens and other organizations to keep bikes and [pedestrians] high on the list, not invisible with only auto drivers acknowledged as the true travelers or commuters."

Where possible, removing vehicle lanes in favor of expanded sidewalks—and here in Cambridge's Central Square, providing space for outdoor seating for restaurants and trees for shade—helps create what some call more livable, sustainable cities.

CDD

Drawing Conclusions

Creating a walkable, bikeable city is not the result of a single initiative or policy. Rather, it is a process that includes several city departments, elected officials, residents, and the business community, and it requires the cooperation of drivers, pedestrians, and bicyclists. As the vehicle population continues to grow faster than the human population, the challenge of sharing the limited street and intersection space grows increasingly difficult. In some cases, Cambridge has removed vehicle lanes in favor of bike lanes and wider sidewalks. Such a proposal might not receive due consideration in some cities, but the changing attitude in Cambridge of "peds and bikes first, cars second" elevates ideas like these from the drawing board to the conference room to the built environment.

The results in Cambridge show that the efforts of the city staff, residents, businesses, and many others have resulted in a city that is one of the easiest places to travel on foot and bicycle. In spite of the number of potential conflicts between vehicles and the large number of people bicycling and walking, serious crashes are rare.

Emerging engineering solutions are just pieces of the success. Most importantly, and by far the most difficult to achieve, is a far-reaching openness to serious accommodations to pedestrian and bicycling needs.

"Every driver is sometimes a walker or biker or transit commuter," notes Davis. "The best thing for all of us is to have a choice to use whatever mode we want."

Jeff Parenti is the principal traffic engineer for the city of Cambridge, which he has served for 5 years. Prior to that, he was the transportation engineer for Brookline, MA, where he started the town's traffic calming program, for which he received the Brookline Conservation Commission's Environmentalist of the Year award in 2000. He holds a BSCE from Carnegie Mellon University and an MSCE from the Georgia Institute of Technology.

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